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**Chen et al.**

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(54) **ELECTRONIC DEVICE HAVING DISPLAY WITH CURVED EDGES**

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(58) **Field of Classification Search**

USPC ..... 349/143, 149, 150, 158  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

6,052,101 A \* 4/2000 Moon ..... G09G 3/2022 345/60  
8,310,614 B2 \* 11/2012 Sasaki ..... G02F 1/1333 349/158

8,599,351 B2 12/2013 Kim  
(Continued)

**FOREIGN PATENT DOCUMENTS**

CN 1952764 7/2010  
KR 20080044434 5/2008

(Continued)

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(57) **ABSTRACT**

A display may have an array of pixels. The array of pixels may have a shape such as a circular shape or other shape with a curved edge. Display driver circuitry may supply data signals to the pixels using folded vertical data lines and bisected horizontal gate lines. Each folded vertical lines may have a first segment in a left half of the array and a second segment in a right half of the display. Curved coupling segments in an inactive area of the display may be used in joining the first and second segments. Display driver circuits may be provided in top and bottom portions of the inactive area to supply data to respective top and bottom portions of the array. Gate driver output buffers may have different strengths in different rows of the array.

**17 Claims, 9 Drawing Sheets**

